Performance of large format transition edge sensor microcalorimeter arrays

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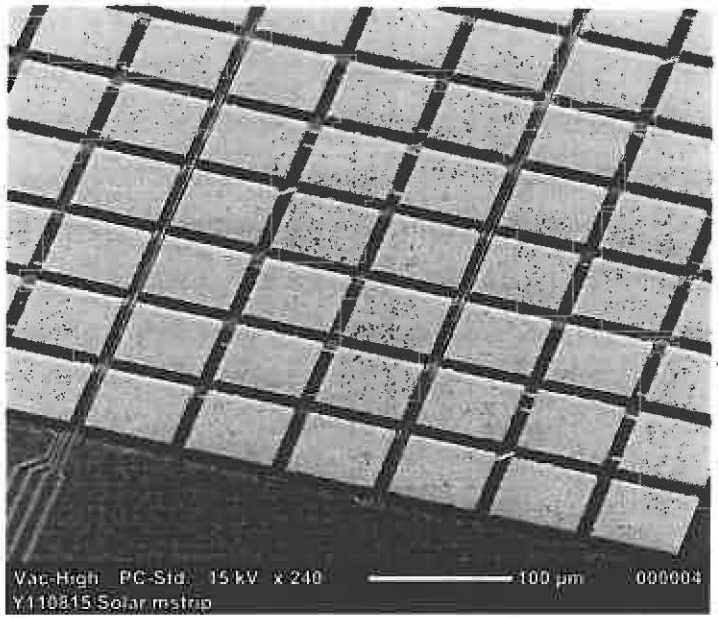
We have produced a variety of superconducting transition edge sensor array designs for microcalorimetric detection of x-rays. Arrays are characterized with a time division SQUID multiplexer such that greater than 10 devices from an array can be measured in the same cooldown. Designs include kilopixel scale arrays of relatively small sensors (~75 micron pitch) atop a thick metal heatsinking layer as well as arrays of membrane-isolated devices on 250 micron and up to 600 micron pitch. We discuss fabrication and performance of microstripline wiring at the small scales achieved to date. We also address fabrication issues with reduction of absorber contact area in small devices.

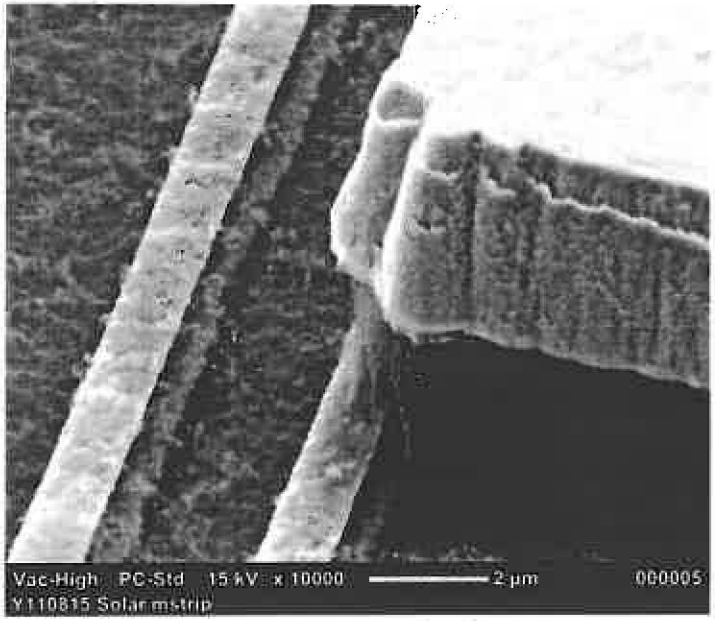
Specifications and expected performance of small pixel, solid susbtrate kilopixel arrays



All pixels wired out

Ground plane integration: superconducting (MoN) and non-superconducting (W) show similar performance. No field control, some flux trapping in MoN sheet

Microstrip wiring performance in kilopixel format with 75 micron pitch

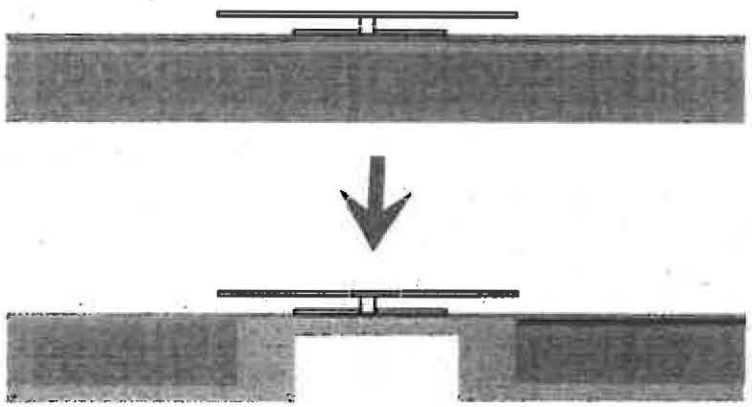


High density leads achieved in close packed focal planes (8 lead pairs per 32 micron munton)

Critical current and electrical crosstalk adequate for array design

Non-uniformity below 10%, observed in pulse height but not traceable to a specific cause yet

Proposal for fabrication reordering in solid substrate devices



Layers

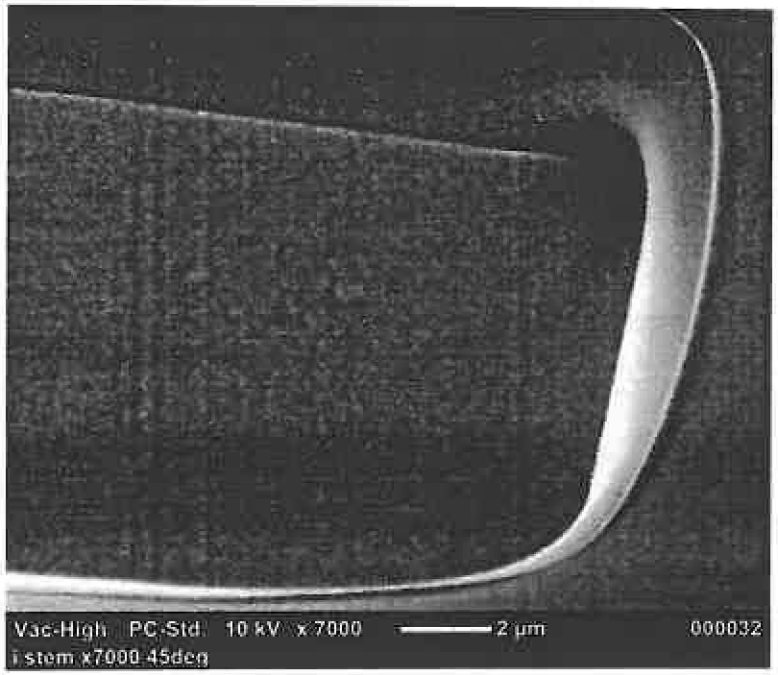
- Device / absorber
- Heatsinking
- Silicon
- Dielectric

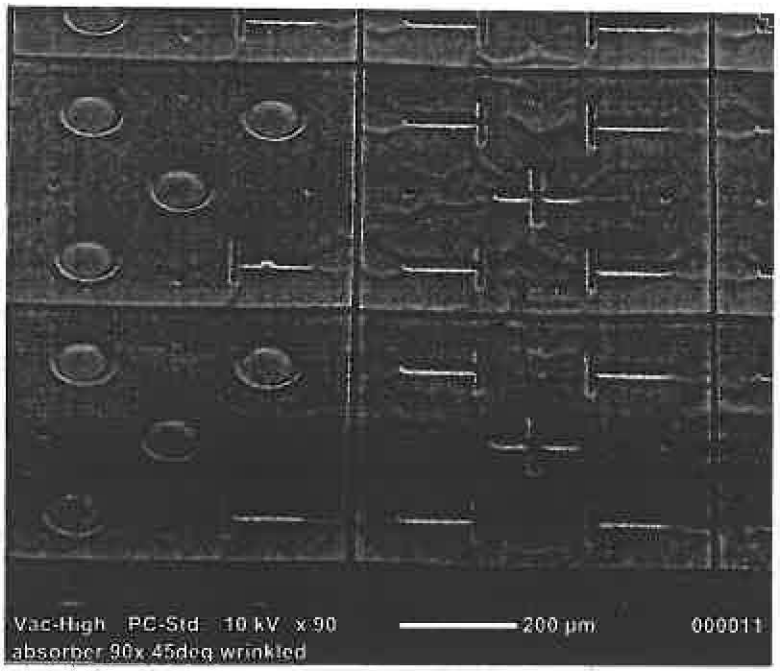
- Device
- Silicon frame
- Heatsinking

Simplifies TES deposition by reducing surface roughness of substrate

Allows examination of possible changes to thermal crosstalk channel

Absorber Integration in Small TES devices



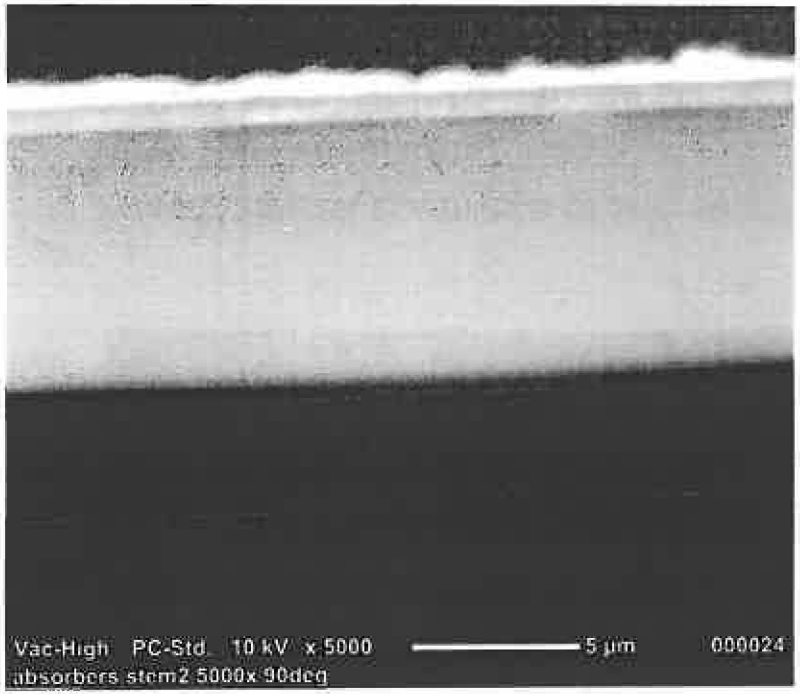


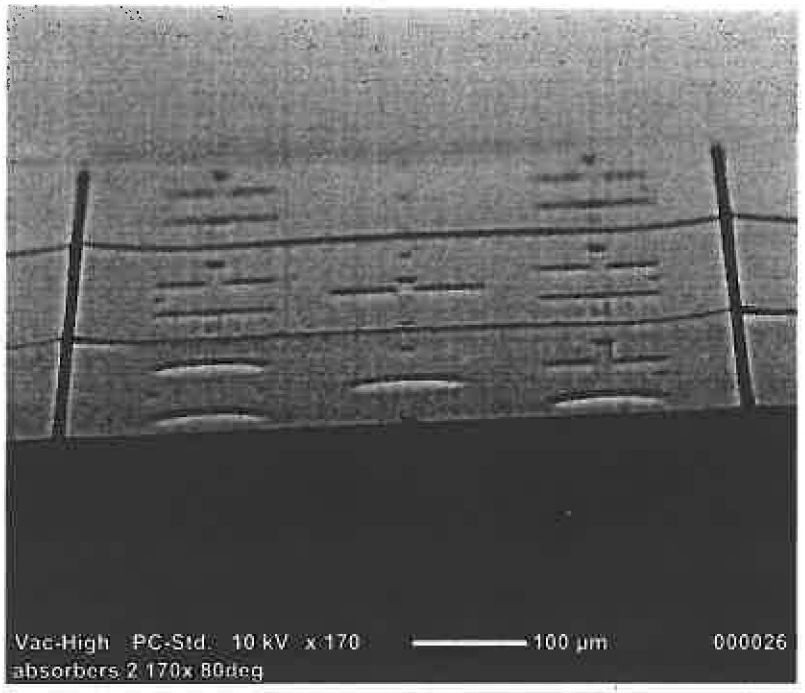
Poor sidewall coverage of the sacrificial layer of resist is an impediment to yielding ultra thin absorbers.

Reflow of resist into narrow stems and around corners can cause pile up that results in poor step coverage of the metal seed layer.

Solvents can penetrate underneath the seed layer and wrinkle the absorber surface.

Absorber Integration II





Good sidewall coverage by the seed layer is essential to yielding thin absorbers.
Reflow of sacrifical resist layer is important in sloping the stem sidewalls.
Wafers must rotate both in altitude and azimuth above the electron beam source during seed layer deposition.
Thinner Au is possible – although geometries with small contact area become harder to yield.